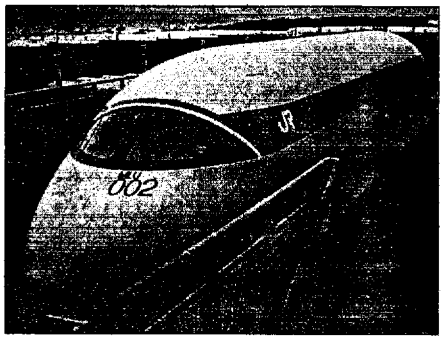
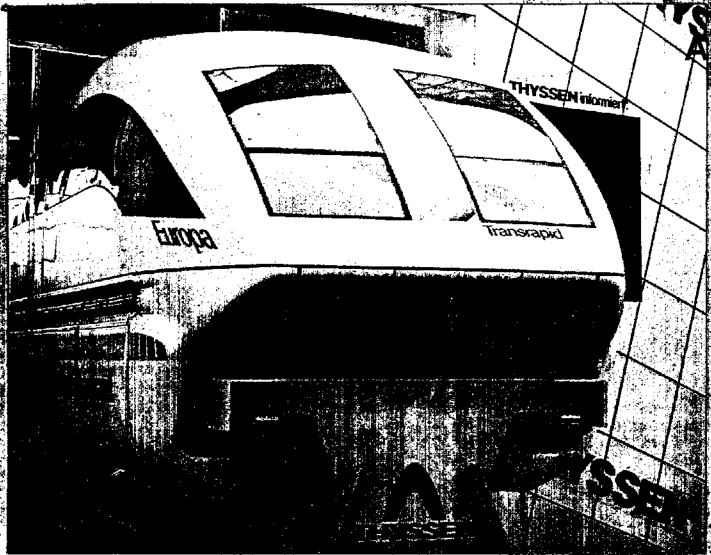
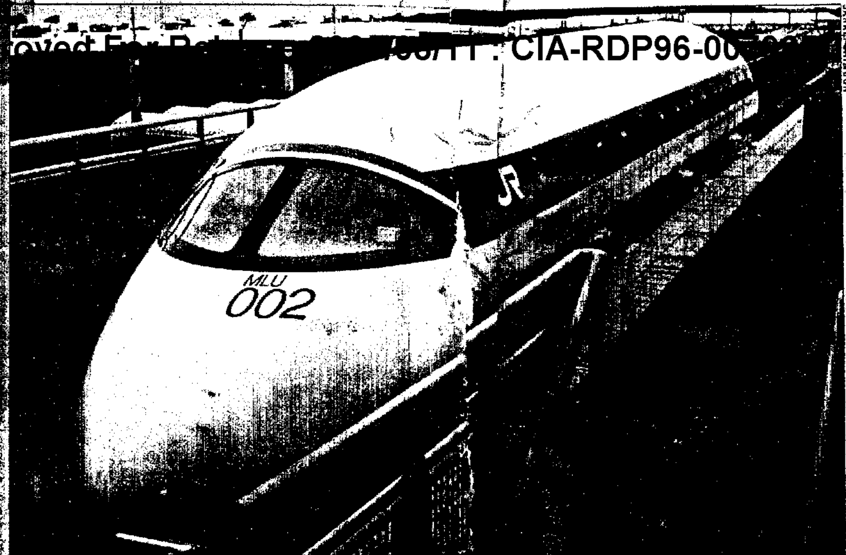
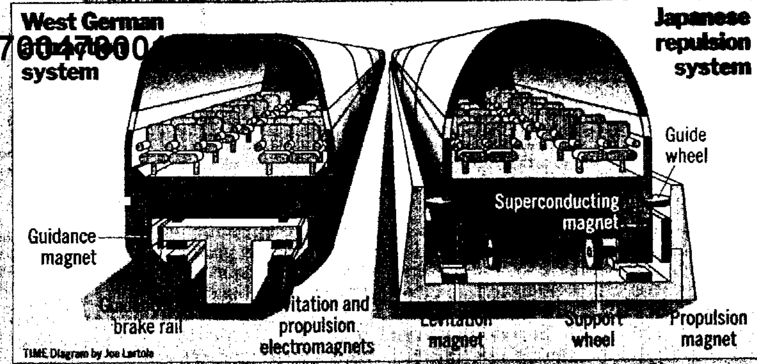
TECHNOLOGY: All aboard the maglev, the levitating, hyperfast train of the future 58



The race is on to build a new breed of trains. With the aid of electromagnets, they will whiz along at speeds of around 300 m.p.h. When they arrive, perhaps in the 1990s, they could revolutionize travel and relieve the pressure on the jammed and increasingly unfriendly skies. The question is who will dominate the market—the West Germans or the Japanese?







The race to levitate: West Germany's [illegible] in the 1990s at 300 m.p.h. [illegible] development but uses [illegible]

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Technology

Floating Trains: What a Way to Go!

Japan and West Germany are in a race with rival high-speed maglevs

Viewed head on and from a distance, the train of the future looks like an overgrown bobsled on stilts. As it approaches on its track, 23 ft. above the ground, it fails almost all the tests of recognition: there are no engines, no wheels, no rails. Most astonishing of all, there is no clatter, no rumble, no screech. As the train hurtles by, there is only a vast whoosh, the sound of air being parted by a vehicle traveling at close to 300 m.p.h.

The new train is called a maglev, a contraction of magnetic levitation. The vehicle lacks that litany of trainlike properties because it floats in the air, supported by the force of immensely powerful magnets. Instead of rolling on rails, it actually flies, using magnets for propulsion. Unhindered by any friction except wind resistance, the maglev can attain speeds unheard of in ordinary land travel—the fastest conventional train, France's TGV *(train à grande vitesse)*, hits only 186 m.p.h. One maglev is already running: a short, slow-moving (25 m.p.h.) line in Britain that shuttles people from Birmingham's airport to the railway station. But much faster prototypes are being tested, and ambitious projects could get under

If maglev trains do indeed get off the tracks by the 1990s, as their builders claim, they will be bound for imminent glory. Seldom has a new leap in technology been as sorely needed. Major air-travel arteries in Europe, the U.S. and Japan are clogging up so badly so fast that the clean, fast and efficient maglev could prove to be their salvation. Not surprisingly, the race to get the maglev to the market has turned into a sprint. Equally unsurprising are the contestants: West Germany and Japan.

There is more than just sporting interest in the rivalry. Although both countries are working on maglevs, their designs are so fundamentally different that victory for one or the other could have profound implications for a whole area of technological development. Japan Railways Group (JR), the leader in the Japanese development, uses a design that relies on magnets made with superconductors, the extraordinary materials that carry electrical currents without resistance. The West German model, known as the Transrapid and built by a consortium that includes Thyssen Henschel, Messerschmitt-Bölkow-Blohm and Krauss Maffei, us[illegible] ventional electromagnets. The West

can get their design into marketable shape soon, they could build a lead in the vital field of superconductors and establish a strong grip on the future of high-speed long-distance train travel.

Another major difference between the two designs is the way the trains levitate. As Manfred Wackers, chief systems analyst for Thyssen's team, puts it, "Our system is attractive. Theirs is repulsive." Meaning: the two systems use opposite ends of the magnet to lift off. In the West German model, winglike flaps extend beneath the train and fold under a T-shaped guideway. Electromagnets in the guideway are activated by a distant control station, their polarity opposite that of electromagnets in the wings. Because of the attraction between the poles, the magnets in the guideway pull on the magnets in the wings, lifting the train ⅜ in.

The Japanese maglev sits in a low, troughlike guideway, paved with two rows of metal boxes containing aluminum coils. Built into the car's undercarriage are six superconducting electromagnets. When one of them passes over an unmag-[illegible] nying magnetic field—is induced in th

tates off the guideway. As the electromagnet moves faster and faster over the coils, the magnetic force becomes more powerful, raising the car to its cruising height of 4½ in. Until the train is moving fast enough to lift off, it rolls on wheels that retract as soon as the maglev hits 106 m.p.h.

The method of propulsion is basically similar in the two systems. In both cases the train effectively rides on an electromagnetic wave. Alternating the current in a set of magnets in the guideway changes their polarity and thus the way they interact with the magnets on the train. As a result, the train is alternately pushed and pulled along. Raising the frequency of the current speeds up the movement. Says Kenji Fujie, chief engineer of JR's maglev laboratory: "We can run it beyond 1,000 k.p.h. [620 m.p.h.], theoretically."

Theoretically, yes. Right now, however, the Japanese decision to rely on superconductors has put them well behind the Germans in development. Reason: commercially feasible superconductors can now be used only at extremely low temperatures. The Japanese magnets must be chilled to −452° F before they achieve perfect conductivity. Turning the thermostat that low requires costly liquid helium and heavy compressors aboard the train to reliquefy the evaporating helium. The Japanese, who have poured $379 million of private and government funds into the maglev, have reached a speed of 323 m.p.h. on a 4.4-mile straight track at Miyazaki on the southern island of Kyushu. But the track has none of the loops and sharp curves found along real railways. It [illegible] the Japanese develop a model that is both

jie: "We firmly believe that our system is the most promising one for the next century and beyond."

That confidence will have to be serene to carry the Japanese through what looks to be years of headlines and television coverage for the West Germans. Their Transrapid program, which has consumed more than $830 million of public funds, is readying its final prototype, the TR-07, for tests on a 20-mile track with loops at both ends at Lathen, near the Dutch border. A previous model, the TR-06, has already run the straightaway at 256 m.p.h.; the TR-07 is designed to reach 300 m.p.h. Most impressive of all, though, is the Transrapid consortium's push to break ground on two major projects, the Los Angeles–Las Vegas link and a 95-mile Hamburg-Hannover line.

The more certain project for the moment is the Hamburg-Hannover line, which the West German government committed itself to building last June, with operation scheduled for the mid-1990s. The track is planned as the first segment of a 600-mile Kiel-Munich line, but not all systems are go yet. Some politicians and many citizens remain unconvinced that the $1.8 billion needed for the first segment will be money well spent, especially with $1.35 billion already allocated for a high-speed conventional-railway project called the Inter-City Experimental. Transrapid supporters, however, do not think the choice between conventional trains and maglevs should be an either-or one. Says one mag-[illegible] Riesenhuber, Minister of Research and Technology: "Sailing

completely overtook sailing ships. That is how it will be with the Transrapid."

A decision on the Los Angeles–Las Vegas line is due in 1989, when a 16-member commission will announce whether Transrapid or a conventional rail builder will receive the contract for the fast track to the gaming tables. No American company is expected to submit a maglev plan. Although the U.S. had a maglev project under way until 1975, federal austerity measures turned off the electromagnets. At least one politician, Democratic Senator Daniel Patrick Moynihan of New York, wants funding for research resumed, but congressional action is not expected before next year.

Despite the absence of a homegrown maglev, enthusiasm in the U.S. is running high for the Transrapid, which would cut travel time between Los Angeles and Las Vegas from five hours by car to 70 minutes by train. Ironically, the Japanese trading company C. Itoh & Co. has pledged to help arrange the $2.5 billion in financing that the West Germans would need to build the California-to-Nevada link. Reason: C. Itoh is Transrapid's agent in Japan and is pondering the possibility of building that system at home.

Even if Transrapid is not awarded the casino-express contract, maglev technology is already on its way to the U.S. Magnetic Transit of America, a subsidiary of West Germany's Daimler-Benz, broke ground in downtown Las Vegas last January for a slower-speed—50 m.p.h.—maglev urban-transit system. Completion of the initial 1.3-mile segment of the Las Vegas People Mover is planned for 1991—perhaps a good year for dating the begin-